INCH-POUND
MIL-B-81592A(AS)
29 October 1993
SUPERSEDING
MIL-B-81592
20 AUGUST 1968

MILITARY SPECIFICATION

BLEED AIR SYSTEMS, LOAD ANALYSIS OF, METHOD FOR

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE.

* 1.1 Scope. This specification presents the method and requirements for preparing a bleed air systems load analysis for aircraft utilizing engine compressor air for various functions. Systems using air from an auxiliary compressor driven off the engine are considered to be bleed air systems. The bleed air load requirements and capacity are determined and presented for each system under specified aircraft flight conditions to prove the adequacy of the air source.

2. APPLICABLE DOCUMENTS

* This section is not applicable to this specification.

3. REQUIREMENTS

3.1 Presentation. The bleed air system load and capacity analysis shall consist of a report, including diagrams, charts, graphs, and summary, in accordance with the methods outlined herein (see 6.3).

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commanding Officer, Naval Air Warfare Center Aircraft Division Lakehurst, Systems Requirements Department, Code SR3, Lakehurst, NJ 08733-5100, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A FSC 16GP

3.2 Form and assembly. The form and assembly of the analysis shall be as specified herein and shall consist of all the applicable items from the following outline, with the bleed air analysis repeated as required for each specified operating condition. The analysis shall be compiled as indicated below. For multi-engined aircraft, consider configurations with bleed air systems inoperative and various engines inoperative.

Item

I. Title page.

II. Table of contents.

III. Introduction.

A. Statement of mission.

B. Bleed air systems schematic (indicate interfaces between engine, QTC components, and airframe components).

IV. Bleed air systems load analyses (chart, see table I).

A. Starting and standing analysis chart or charts.

B. Taxi analysis chart.

C. Takeoff and climb analysis chart.

D. Cruise analysis chart for speeds of loiter, maximum range, and maximum continuous power.

E. Idle descent chart.

F. Approach analysis chart.

1. Single engine approach analysis chart.

G. Landing analysis chart.

1. Single engine landing analysis chart.

H. If above does not include most critical condition, add here.

V. Graphical load analyses.

VI. Summary.

VII. Conclusions.

3.2.1 Numbering of pages. The pages of the bleed air system load and capacity analysis shall be numbered consecutively from 1 beginning on the introduction page.

TABLE I. Load analysis chart.

Security classification

Aircraft designation report no.

Operating condition: Ambient air temperature Aircraft altitude			Aircraft airspeed Engine speed				
	Bleed air flow (lbs/min)		Bleed air press. (PSIA)		Bleed air temp. (°F)		Heat load for cooling or heating systems
Operating system	Needed	Supplied (by engine & stage if applicable)	Needed	Supplied	Needed	Supplied	
Boundary layer control Rain removal, jet blast, defogging, defrosting, ice protection Engine inlet Radome Pitot Air scoops Wing Windshield Empennage Other							

TABLE I. Load analysis chart - continued.

Security classification

Aircraft designation report no.

Operating condition: Ambient air temperature Aircraft altitude	Aircraft airspeed Engine speed						
Operating system	Bleed air flow (lbs/min)		Bleed air press. (PSIA)		Bleed air temp. (°F)		Heat load for cooling or heating
	Needed	Supplied (by engine & stage if applicable)	Needed	Supplied	Needed	Supplied	
Air conditioning system Cabin heating Cabin cooling Cabin pressure Press. suit heating Press. suit cooling Press. suit press. (Other) Fuel tank pressurization Equipment heating							

* TABLE I. Load analysis chart - continued.

Security classification Aircraft designation report no.

Operating condition: Ambient air temperature Aircraft altitude			Aircraft airspeed Engine speed				
Operating system	Bleed air flow (lbs/min)		Bleed air press. (PSIA)		Bleed air temp. (°F)		Heat load for cooling or heating
	Needed	Supplied (by engine & stage if applicable)	Needed	Supplied	Needed	Supplied	
Equipment cooling and pressurization (Itemize by subsystem) Engine nacelle cooling Bleed and precooler cooling air Vortex generator Leakage Other (controls, air turbine drives, pressure seals TOTALS							

3.2.2 Entries. Entries may be typed or lettered, or both.

3.2.2.1 Limits of significance. In general, no entries need be made with more than three significant figures, rounded off to the nearest digit in the third place.

3.2.3 Multicondition and analyses. When space permits, load analyses for two or more individual flight conditions may be reported on one chart, provided that the individual analyses are clearly separated and identified.

3.3 Title page. The title page shall contain the following information.

Title: Aircraft Engine Compressor Bleed Air System Load and Capacity Analysis

Manufacturer

Aircraft model and engine designation and engine specification number

Aircraft serial numbers

Report number

Number of pages

Report date

Contract number

Security classification

Official address (manufacturer's)

3.3.1 Other information. Additional information may be presented on the title page at the option of the contractor.

3.4 Table of contents. There shall be a table of contents which shall consist of a listing of the various parts of the analysis.

3.5 Introduction.

3.5.1 Description statement. There shall be a statement consisting of a brief description of the aircraft mission with any general explanations which will serve to clarify the function of the bleed air system with respect to the mission.

3.5.2 Bleed air system schematic. There shall be a bleed air system schematic diagram illustrating the various bleed air systems, flow diagram including flow-regulating and the shut-off devices, automatic control mechanisms, and operating temperatures and pressures at various locations in the system.

* 3.6 Load analyses. Loads analyses for bleed air systems shall be on a chart conforming to table I. The load analyses are used to determine the total bleed air requirements for each aircraft operating condition at the most adverse environmental conditions. The operating conditions listed in the following paragraphs are typical for military aircraft. These conditions shall be analyzed in the order given; and the special conditions applicable to the particular aircraft shall be analyzed in additional operating conditions columns. Cooling air requirements for electronic and other equipment shall be itemized by subsystems for each flight condition. This may be on the flight condition load analysis chart to which the particular data is related or the equipment cooling data may be on a separate load analysis chart. Heating and pressurization requirements shall be itemized for each compartment or piece of equipment which is heated or pressurized.

3.6.1 Operating conditions.

3.6.1.1 Starting and standing. Starting and standing is that condition from starting the engines and standing idle until taxiing to the runway.

3.6.1.2 Taxi. Taxi is that condition from the aircraft's first movement on the ground to the start of the takeoff run.

3.6.1.3 Takeoff and climb. Takeoff and climb is that condition commencing with the takeoff run and ending with the aircraft leveled off and set for cruising.

3.6.1.4 Cruise. Cruise is that condition in stabilized level flight in which the combinations of bleed air demand and supply most closely approach each other. Speeds from maximum endurance (loiter) to full power and various altitudes, at design gross weight, should be investigated; the selection of cruise condition should be justified in the report. If loiter is achieved with one or more engines inoperative, this configuration should be considered.

3.6.1.5 Idle descent. Idle descent is that condition when the aircraft altitude is reduced with the engines operating at idle revolutions per minute (rpm).

3.6.1.6 Let-down and approach. Approach is that condition during which the aircraft is trimmed for landing and is nearing the landing area.

3.6.1.6.1 Single engine let-down and approach. Single engine approach is that approach condition wherein one or more engine(s) is (are) inoperable. The number of operating and non-operating engines shall be indicated.

3.6.1.7 Landing. Landing is that condition between runway contact and securing of the aircraft at the completion of the aircraft mission.

3.6.1.7.1 Single engine landing. Single engine landing is that landing condition wherein one or more engine(s) is (are) inoperable. The number of operating and non-operating engines shall be indicated.

3.6.2 Operating data. Data shall have been obtained from steady-state load conditions while operating at the most adverse environmental conditions.

3.6.2.1 Airflow. Airflow shall be recorded in pounds per minute (lbs/min) for the specific operating conditions.

3.6.2.2 Temperatures. Temperatures shall be recorded in degrees Fahrenheit.

3.6.2.3 Airspeed. Aircraft airspeed shall be recorded in knots. Indicated, true, equivalent airspeeds, or Mach number may be used to suit the system favored by the contractor. Units and system shall be explicitly designated in the report.

3.6.2.4 Engine speed. Aircraft engine speed shall be recorded as percent (%) of engine normal speed (normal thrust) rpm.

3.6.2.5 Demand airflow. Demand airflow for each system shall be recorded in lbs/min for the specific operating condition. The total demand airflow shall not exceed the allowable bleed airflow (see 3.6.2.6).

3.6.2.6 Allowable bleed airflow. Allowable bleed airflow shall be recorded in lbs/min and percentage of source intake air. This value shall be based on the engine detail specification for the stated operating condition.

* 3.7 Graphical analyses. The graphical analyses shall compare the demand airflow (see 3.6.2.5) and the allowable airflow (see 3.6.2.6) in cold, hot, and standard atmospheres as specified in the aircraft detail specification, for each of the operating conditions of 3.6.1.

3.8 Summary. A summary shall be compiled indicating the minimum excess airflow for each operating condition analyzed and the conditions which create this excess.

3.9 Conclusions. The conclusions shall consist of statements attesting to the engine compressor in providing the bleed air system with a supply of air for its functions under all flight conditions under the most severe environment for each analysis. The conclusion shall declare that the limits specified herein have not been exceeded.

4. QUALITY ASSURANCE PROVISIONS

* This section is not applicable to this specification.

5. PACKAGING

This section is not applicable to this specification.

6. NOTES

* (This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. The bleed air load analysis is intended for determining the adequacy of the bleed air system to provide for its functions during the flight operations specified herein, and to evaluate engine performance penalties associated with the bleed air systems.

* 6.2 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number and date of this specification.

* 6.3 Data requirements. The following Data Item Descriptions (DID's) must be listed, as applicable, on the Contract Data Requirements List (DD Form 1423) when this specification is applied on a contract, in order to obtain the data, except where DOD FAR Supplement 227.405-70 exempts the requirement for a DD Form 1423.

Reference paragraph	DID Number	DID Title	Suggested Tailoring
3.1	DI-GDRQ-80650	Design data and calculations	---

The above DID's were those cleared as of the date of this specification. The current issue of DOD 5010.12-L, Acquisition Management Systems and Data Requirements Control List (AMSDL), must be researched to ensure that only current, cleared DID's are cited on the DD Form 1423.

* 6.4 Subject term (key word) listing.

Aircraft
Airflow
Compressor air

* 6.5 Changes from previous issue. The margins of this specification are marked with asterisks to indicate where changes (additions, modifications, corrections, deletions) from the previous issue were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the past previous issue.

Preparing Activity:
Navy - AS

(Project No. 16GP-N015)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER	2. DOCUMENT DATE (YYMMDD)
	MIL-B-81592A(AS)	93/10/29

3. DOCUMENT TITLE

BLEED AIR SYSTEMS, LOAD ANALYSIS OF, METHOD FOR

4. NATURE OF CHANGE (*Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.*)

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME (Last, First, Middle Initial)	b. ORGANIZATION	
c. ADDRESS (Include Zip Code)	d. TELEPHONE (Include Area Code) (1) Commercial (2) AUTOVON (If applicable)	7. DATE SUBMITTED (YYMMDD)

8. PREPARING ACTIVITY

a. NAME	b. TELEPHONE (Include Area Code)	
COMMANDING OFFICER, NAVAL AIR WARFARE CENTER AIRCRAFT DIVISION LAKEHURST SYSTEMS REQUIREMENTS DEPARTMENT	(1) Commercial (908) 323-7488	(2) AUTOVON 624-7488
c. ADDRESS (Include Zip Code) CODE SR3 LAKEHURST, NJ 08733-5100	IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Quality and Standardization Office [illegible]3, Falls Church, VA 22041-3466 TOVON 289-2340	